PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
H04N 5/655	A1	WO 99/26414
		(43) International Publication Date: 27 May 1999 (27.05.99)

(21) International Application Number: PCT/US98/24002

(22) International Filing Date: 10 November 1998 (10.11.98)

(30) Priority Data:

60/065,223	13 November 1997 (13.11.97)	US
09/167,817	7 October 1998 (07.10.98)	US

(71) Applicant: AQUA COMMUNICATIONS, INC. [US/US]; 359 Green Street, Cambridge, MA 02139 (US).

(72) Inventors: ASKLING, Kevin; Apartment 16, 74 Craigie Street, Somerville, MA 02143 (US). GOODRICH, Elizabeth; 112 Beech Street, Roslindale, MA 02131 (US). MASSEY, Laurence; 144 Savin Hill Avenue, Boston, MA 02125 (US).

(74) Agent: CONRAD, Philip, L.; Kudirka & Jobse, LLP, Two Center Plaza, Boston, MA 02108 (US).

(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: HANDHELD ROTATABLE VIDEO DISPLAY

(57) Abstract

A handheld rotatable display is comprised of a display housing assembly and handle assembly, wherein the display housing assembly may be rotated up to about ±175 degrees, relative to the handle assembly. The display housing assembly includes a display housing, a display screen, and display electronics. The handle assembly allows a user to hold and control the handheld rotatable display. In a first embodiment, the handle assembly includes a rotation control mechanism, comprised of an actuator and gears, which allow the display housing, and screen therein, to be rotated. In a second embodiment, the actuator is part of the display housing assembly. In both embodiments, the handle assembly also includes controls for display brightness, power, and turning a light source used in conjonction with a camera on and off. The display can receive power from either an AC adapter or DC battery. Furthermore, the display can display, receive, and transmit video image data.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

HANDHELD ROTATABLE VIDEO DISPLAY

FIELD OF THE INVENTION

The invention relates generally to video display devices. Specifically, the invention relates to portable handheld video displays.

BACKGROUND OF THE INVENTION

This application takes priority from the provisional application filed with the United States Patent and Trademark Office on November 13, 1997, USPTO Serial Number 60/065,223 entitled HANDHELD ROTATABLE DISPLAY.

With the continued technological advances in electronics, it has become increasingly common for electronic devices, e.g., video electronics, audio electronics, and computers, to be applied in a wide variety of situations. For example, in the area of equipment maintenance and inspections, electronic systems are increasingly used to discover and diagnose problems, as well as to aid in the conduct of repairs. One type of electronic equipment used with increasing frequency in maintenance situations is video systems. In one case, a video system may provide the only real-time viewing of an area being inspected or maintained, because the maintainer himself does not have a direct line-of-sight to the area. In yet another case, a video system may
be used to provide video information relating to the conduct of the repair itself, such as when maintenance procedures are provided by video display. In such cases, the quality of the video images or display capability often affects the ultimate utility of the video display itself, such as when high resolution is required to distinguish important features. Additionally, portability may also relate to the effectiveness of the display. For example, a standard desktop computer display may become difficult to view as a maintainer alters his position throughout

his equipment repair, such as when an auto mechanic gets underneath an automobile. Also, a difference in the orientation the video images being displayed and the orientation of the equipment being inspected or repaired may complicate the maintainer's tasks.

In another situation, an individual may desire to record video images using a remote camera and simultaneously view the images being recorded. For example, a news camera crew may have their camera mounted on a pole so that it can be raised above a crowd to capture video images of something the crew itself can not see. In such a case, a portable display used in conjunction with the camera to ensure that the camera crew is capturing the event as desired would be particularly useful. Additionally, given the requirement of high mobility for a news crew, a highly portable display is advantageous for increasing the crew's ability to respond to late breaking events rapidly.

SUMMARY OF THE INVENTION

The invention is a handheld rotatable display, capable of being controlled and manipulated during use by the hand with which it is held. The invention is described with respect to two embodiments thereof. In these embodiments, the display is comprised of two assemblies which are rotatably attached to each other. First, a display housing assembly includes a display body, which encases and secures a high-resolution display screen and display electronics. One preferred form of the display screen is a 5-inch color TFT-LCD display with a resolution of 960x234 pixels. The display housing assembly is rotatably connected to a handle assembly, such that the display housing assembly is rotatable with respect to the handle assembly, up to approximately plus or minus 175°.

The handle assembly includes a handle body, which encases and protects the electronics that control the display. The handle assembly and display housing assembly each include components of a rotation control mechanism. In a first embodiment, the rotation control

mechanism is implemented as a mechanical set of gears driven by a thumb wheel, wherein the thumb wheel extends through the handle body for access by the user. In a second embodiment, the thumb wheel is integrated into the display housing assembly and a single gear is used to achieve rotation of the display housing assembly with respect to the handle assembly. Beyond the two embodiments of rotation control mechanisms, the two embodiments are substantially the same. For instance, in both embodiments, controls to turn the display on and off, to adjust the brightness of the display, and to turn a camera light source on and off also extend through the handle body. A hand strap is also included, which allows the user to secure the handheld rotatable display to his hand. The hand strap is located at the rear of the handle assembly, and extends from a top end of the handle assembly to a bottom end.

The display can accept power through either an external AC power source or through the use of a battery. Accordingly, the handle assembly includes a standard AC adapter port and a battery compartment. Also, a camera input port is located at the bottom end of the handle assembly, which accepts a connection from a camera or other video transmission device. And, a video input/output (I/O) port in the handle assembly allows video image data to be transmitted from the display to a different display or to be received from a different video transmission device.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features, objects and advantages of the invention will be better understood by referring to the following detailed description in conjunction with the accompanying figures, as described below.

Figure 1 is a perspective view of a handheld rotatable display in accordance with a first embodiment of the invention.

Figure 2 is a rear perspective view of the handheld rotatable display shown in Figure1.

Figure 3 is a bottom view of the aforementioned handheld rotatable display.

Figure 4 is an exploded view of the display housing assembly of the rotatable display of Figure 1.

Figure 5 is an exploded view of the handle assembly of the rotatable display of Figure 1.

Figure 6 is a partially decomposed rear perspective view of the handheld rotatable display of Figure 1.

Figure 7 is an exploded top view of the rotation control mechanism of a second embodiment of the invention.

Figures 8A, B, and C are a front (internal) view, a top perspective view, and a side perspective view, respectively, of a rear display body piece of the control mechanism of Figure 7.

Figures 9A, B, and C are a front view, a front perspective view, and a rear perspective view, respectively, of a display rotation gear of the control mechanism of Figure 7.

Figures 10A, B, and C are a front view, a rear perspective view, and side view, respectively, of an interface plate of the control mechanism of Figure 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is described herein with reference to a first and a second embodiment. Each embodiment accomplishes the objects of the present invention, in part, using a rotation control mechanism, which is used to rotate the display screen of the handheld rotatable display with respect to the handle assembly thereof. Generally, differences in the rotation control mechanisms of the two embodiments are reflected in variations in the rotation actuator, gears, handle assembly interface plate, and display body rear piece of each embodiment. As described in detail below, the first embodiment

integrates into the handle assembly a rotation actuator, which is the part of the rotation control mechanism manipulated by the user to rotate the display screen. In the second embodiment, the rotation actuator is integrated into the display housing assembly. Beyond the differences in the rotation control mechanisms, the two embodiments are substantially the same in other respects.

Figure 1 shows a handheld rotatable display 100 that is comprised of two subassemblies. These subassemblies are display housing assembly 200 and the handle assembly 300, which, for the most part, are common to both embodiments. The display housing assembly 200 is rotatably connected to the handle assembly 300, such that the display housing assembly 200 can be rotated up to approximately plus or minus 175° with respect to the handle assembly 300. Video cable 312 provides a means for reception of video image data from an external video source, e.g., a video camera.

A video image, formed from processing the video image data, is displayed on a display screen 204. In the preferred embodiments, the display screen 204 is a glass screen, which is secured in place within display body 202. The display body 202 is the component of the display housing assembly 200 that forms a rotatable connection with the handle assembly 300. Ultimately, this rotatable connection allows the screen 204 to be rotated. A rotation control actuator provides a mechanism by which a user holding the handheld rotatable display 100 by the handle assembly 300 can control the rotation of the display screen 204 with the hand that is holding the display 100. Figure 1 shows the first embodiment, wherein thumb wheel 304, in conjunction with gears internal to the handle assembly 300, causes a corresponding rotation of the display body 202 relative to the handle assembly 300 when thumb wheel 304 is rotated. Thumb wheel 304 is located at a top end of the handle assembly 300, so that it may be rotated by the thumb of the hand which holds the display 100.

The handle assembly 300 includes feature control buttons positioned to be easily accessible by the hand which holds the handheld rotatable display 100. In the preferred embodiments, these feature control buttons are a light source button 310, a display brightness button 306, and a power on/off button 308. As discussed in more detail with respect to Figure 2, each of the control buttons is oriented within the handle assembly 300 to be in close proximity to the rotation actuator, i.e., thumb wheel 304, and similarly accessible. The orientation of these controls allows the user to easily access any of them with the thumb of the hand which holds the display without altering the user's grip of the display.

The light source button 310 allows a light source (not shown) used in conjunction with the video camera (not shown) to be remotely turned on and off when the button is depressed. Control is achieved by the transmission of a light source control signal from the handheld rotatable display 100 to the light source via video cable 312 in response to depression of the light source button 310. If the particular camera being used does not include a light source, then this button 310 is otherwise inoperative and may be excluded. Brightness button 306 provides a mechanism by which the brightness of the video image being displayed on screen 204 can be adjusted. Power on/off button 308 provides a mechanism for turning the display on and off. In one embodiment, the camera being used with the display receives its power and control from the display 100 via the video cable 312. Therefore, depression of power button 308 would not only turn the display on and off, but the camera and the light source as well. Functional controls for display brightness and power are otherwise known in the art, and are not described in any further detail herein.

Figure 2 shows the handheld rotatable display 100 of the first embodiment from a rear perspective view. Once again, the display housing assembly 200 and handle assembly 300 are each shown. Thumb wheel 304, brightness button 306, power on/off button 308, and

light source button 310 are shown at the top end of the handle assembly 300. As can be seen from the rear perspective view, the handle assembly 300 is contoured to be elongated from the top end (area of thumb wheel 304) to a bottom end. The contour is such that it is narrow with respect to a typical user's hand and, thereby, facilitates easy gripping by one hand of the user. In conjunction with the contoured handle assembly 300, a hand strap 314 is provided to allow the user's hand to be secured to the handle assembly 300. For example, the user would insert his right hand in the direction of arrow 400, which would orient his thumb so that it could control and access the thumb wheel 304, brightness button 306, power button 308, and light source button 310. Strap bars 316, 318 secure the hand strap 314 to the handle assembly 300, at each of the handle assembly's top and bottom ends. A left-handed user would insert his hand in direction of arrow 410 and, consequently, his thumb would be positioned to access the feature controls 306, 308, 310 and thumb wheel 304.

Figure 3 shows a bottom view of the handheld rotatable display 100. In the preferred embodiments, the handheld rotatable display 100 can be powered in either of two ways. First, the display 100 may be powered using a DC battery which inserts into a battery compartment within the display handle assembly 300 via battery compartment door 320. Alternatively, the display 100 may be powered using an AC adapter, which plugs into the display handle assembly 300 via a standard AC adapter plug 322. Such AC adapter plugs and batteries are well known in the art and are not discussed herein further. Video input/output (I/O) port 326 accepts a standard video I/O plug which allows video image data to be transmitted from the handheld rotatable display 100 to another video receiver (not shown), such as another video display, or allows video data to be received by the display 100 from another video source (not shown). Such video input/output plugs and ports are standard and well known in the art. Interface plate 328 and display housing assembly 300 are discussed in more detail below.

A variety of signals are accommodated by camera input port 324, which is a standard DIN connector comprised of five pins in the preferred embodiments. One of the five pins is controlled by light source button 310 (see Figure 2) and is dedicated to the control of a light source used in conjunction with a camera, if such a camera and light configuration is implemented. Another pin is controlled by the power on/off button 308 and is dedicated to the supply of power provided by the handheld rotatable display 100 to a video transmitter, e.g., a video camera. As described earlier, power on/off button 308 also controls the supply of power to the handheld rotatable display 100 itself. The remaining three pins within plug 324 are used for the reception of video image data from a video transmitter, such as a video camera. The video cable 312 (see Figure 1) connects such a video transmission device to plug 324 of the handheld rotatable display 100.

Figure 4 is an exploded view of the display housing assembly 200. A display body front piece 206 and a display body rear piece 210 comprise the basic structure of the housing and securely hold display screen 204 and display electronics board 208 in place. Display screen 204 and the display screen electronics board 208 together comprise a standard 5 inch TFT-LCD high resolution 960x234 pixel color display. Such display components are known in the art and are not discussed herein in further detail. The display body rear piece 210 shown in this figure, is that of the first embodiment. Accordingly, rotation channel 212, within display body rear piece 210, accepts a lip formed within the handle assembly 300, wherein together the channel 212 and lip form a rotatable interface between the display housing assembly 200 and the handle assembly 300. Display body wire opening 214 in the display body rear piece 210 allows electrical wires to be passed from the handle assembly 300 to the electronics board 208 without being adversely affected by the rotation of the display housing assembly 200 with respect to the handle assembly 300. The wires may actually experience some rotation, but with adequate wire length and the fact

that the display assembly's rotation is limited in either direction, such rotation can be made to not cause undue stress on the actual wire connections. Additionally, as will be discussed in more detail below, a gear interface 216 is integrated into the display body wire opening 214 and rigidly secures to a display rotation gear 350 of the handle assembly 300.

Figure 5 shows an exploded view of the display handle assembly 300 implementing the rotation control mechanism of the first embodiment. An interface plate 328 and handle body 302 together comprise the basic housing of the handle assembly 300. In the preferred embodiments, interface plate 328 and handle body 302 are made of lightweight durable plastic. The use of such a material is consistent with the highly portable nature of the handheld rotatable display 100. The interface plate 328 shown in this figure is that of the first embodiment. The handle body 302 attaches to the interface plate 328 using screws (not shown) which originate outside handle body 302 and fit through handle body openings, such as opening 344, and secure into screw receptors 342 in interface plate 328. The interface plate 328 includes a circular lip (not shown) which, in the first embodiment, inserts into rotation channel 212 of the display body rear piece 210 shown in Figure 4. Together, the circular lip and rotation channel 212 form a rotatable interface between the display assembly 200 and handle assembly 300, when display assembly 200 and handle assembly 300 are attached together. The rotatable interface is such that when the handle assembly 300 and display assembly 200 are rotated with respect to each other, the lip glides within the channel 212.

Brightness button 306, power on/off button 308, and light source button 310 originate within handle body 302 at electrical switches 336 and extend up through handle body 302 to be accessible by the user. Battery 332 fits into a battery compartment defined within the handle body 302 and is locked therein by securely closing battery compartment door 320. Battery contacts 334 provide a means for

power to be provided from the battery to the switches 336. Camera input port 324 is shown and originates within handle body 302 and extends through the body to be available for connection by a video cable 312 external to the handle body 302. As discussed below, a handle body opening 338 in interface plate 328 plays a role in the rotatable connection between the display assembly 200 and handle assembly 300. PC board 340 provides the main structure for defining the battery compartment for battery 332 and hosting switches 336 and contacts 334.

The rotation control mechanism of the first embodiment is described in detail with reference to Figures 5 and 6, and to a lesser degree with reference to Figure 4. Thumb wheel 304 (shown partially cut away in Fig. 6) operates in conjunction with a gear train to accomplish the rotation of the display housing assembly 200 with respect to the handle assembly 300, when thumb wheel 304 is rotated. In the first embodiment, the gear train is comprised of a one-inch thumb wheel gear 346, an idle gear 348, and a one-inch display rotation gear 350. The thumb wheel 304 and thumb wheel gear 346 are secured together and co-axially mounted to thumb wheel gear post 352. That is, thumb wheel gear 346 rotates with thumb wheel 304 when the thumb wheel is rotated, so they do not rotate with respect to each other. Idle gear 348 is mounted on middle gear post 354 such that idle gear 348 is substantially coplanar with thumb wheel gear 346. Additionally, idle gear 348 stays in contact with thumb wheel gear 346 throughout their coincident rotation. When thumb wheel 304 is rotated, thumb wheel gear 346 rotates and causes idle gear 348 to rotate about middle gear post 354 in the opposite direction of the thumb wheel gear's 346 rotation.

Display rotation gear 350 slidably fits into handle body opening 338 such that an outer rim of the display rotation gear 350 is large enough so as not to fit into or through handle body opening 338, keeping it on the handle body 302 side of interface plate 328.

However, display rotation gear 350 is secured to the gear interface 216 (see Fig. 4) portion of display body rear piece 210, by inserting screws, for example, through the two rotation gear screw openings 358 in the display rotation gear 350 which fasten into the two screw receptors 218 shown in the gear interface 216. Like gear interface 216, display rotation gear 350 includes a wire opening 362, which allows wires to be passed between the display housing assembly 200 and handle assembly 300. The securing of display rotation gear 350 to gear interface 216 allows the display assembly 200 to rotate coincident with the rotation of the display rotation gear 350, while the display rotation gear freely rotates within handle body opening 338. When assembled, display rotation gear 350 is substantially coplanar with idle gear 348 and stays in contact therewith. Consequently, when thumb wheel 304 is rotated clockwise, thumb wheel gear 346 rotates clockwise with it and idle gear 348 rotates counterclockwise in response. And, when idle gear 346 rotates counterclockwise, display rotation gear 350 and display assembly 200 are caused to rotate clockwise in response. In this way, the display housing assembly 200 is caused to rotate in response to, and in the same direction as, the rotation of thumb wheel 304.

The rotation control mechanism of the second embodiment is described in detail with reference to Figures 7, 8A-C, 9A-C and 10A-C. Unlike the first embodiment, the rotation actuator, i.e., thumb wheel 404, is part of the display housing assembly in this embodiment. Figure 7 shows the handle body 402, display rotation gear 450, interface plate 428, and display body rear piece 250, including thumb wheel 404, of the second embodiment. These components, while disassembled, are shown ordered with respect to each other according to their ultimate assembled orientation. For instance, interface plate 428 and display body 402 form the basic outer structure of the handle assembly. Handle body screws 454 pass through screw openings 344 and threadably insert into screw receptors 442 in interface plate 428,

thereby rigidly securing display body 402 to interface plate 428. Consequently, display rotation gear 450 is encased within the handle assembly when interface plate 428 and handle body 402 are secured together, but the display rotation gear 450 is allowed to rotate therein. Display rotation gear 450 attaches to display body rear piece 250 using rotation gear screws 456, wherein the threaded portion of screws 456 are each inserted through a different opening in the display rotation gear 450, pass through handle body wire opening 438 (see Figure 10A), and secure to display body rear piece 250. Since, when the components are assembled, the display rotation gear 450 is encased within the handle assembly 400, the display housing assembly is, consequently, rotatably secured to the handle assembly 400.

Figures 8A, B, and C show the display rear body piece 250 of the second embodiment from three views. In this embodiment, thumb wheel 404 is part of the molded plastic display rear body piece 250, as shown in Figures 8B and 8C. The thumb wheel 404 is corrugated to facilitate easy gripping by an individual's thumb. Rotation of the thumb wheel 404 causes a corresponding rotation of the display housing assembly and, thereby, the display screen. The positioning of thumb wheel 404 at the back of the display rear body piece 250 allows the thumb wheel to be accessed by the thumb of an individual gripping the handheld rotatable display by the handle body 402, as described above with reference to Figure 2. Similar to the first embodiment, a display body wire opening 254 is provided to allow wires to be passed between the display housing assembly and handle assembly 400. Again like the first embodiment, gear interface 256 includes screw receptors 258, shown in Figures 8A and 8B, that accept the rotation gear screws 456 of Figure 7 and, thereby, rotatably attach the display housing assembly to the handle assembly 400. Also, rotation channel 252 is formed in the display body rear piece 250 to accommodate insertion of a circular lip 464 formed in the interface plate 428 of Figure 10A, when the apparatus is assembled. The rotation channel 252 includes a channel

detent 260, which prohibits further rotation of the display housing assembly when contact is made with lip stopper 468 of the circular lip 464, also shown in Figure 10A.

Figures 9A, B, and C show the display rotation gear from three views. As shown in Figure 9A, three rotation gear screw openings 458 are provided. And, as described earlier, rotation gear screws 456 insert into the rotation gear screw openings 458 from the back side of the rotation gear 450 (see Figure 9C), as depicted by arrow 460. Consequently, the screw heads reside within the depressions shown at the rotation gear screw openings 458. Like the display rotation gear 450 of the first embodiment, shown in Figures 5 and 6, the display rotation gear 450 of the second embodiment includes a wire opening 462, which allows wires to be passed between the display housing assembly and handle assembly 400. Display rotation gear 450 slidably fits into handle body opening 438 (see Figure 10A) such that the outer rim 466 of the display rotation gear 450 is large enough so as not to fit into or through handle body opening 438, keeping it on the handle body 402 side of interface plate 428. As a result, display rotation gear 450 is allowed to rotate therein.

Figures 10A, B, and C show three views of the interface plate 428 of the second embodiment. The interface plate 428 includes a handle body opening438. This opening makes a rotatable pressure fit with the display rotation gear 450 within that handle assembly 400, and allows the display rotation gear 450 and display housing assembly to be attached together and rotate with respect to the handle assembly 400. The interface plate 428 includes screw receptors 442 into which handle body screws 454 are secured, thereby rigidly securing together the handle body 402 and interface plate 428. Referring to Figure 10A, a circular lip 464 is formed within the front of the interface plate 428, and contacts the display body rear piece 250, shown in Figure 8B. The lip 464 resides within the rotation channel 252 (see Figure 8B) of the display body rear piece. The circular lip 464 includes a lip 468, which

stops the rotation of the display housing assembly with respect to the handle assembly 400 when lip 468 contacts the channel detent 260 of the display body rear piece 250 of Figure 10B.

While the invention has been shown and described with reference to multiple embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail may be made herein without departing from the spirit and scope of the invention, as defined by the appended claims. For example, while the camera input port has been shown as an electrical DIN type connector providing a variety of control signals, to be used with a video cable, signals and data could also be exchanged using others means. In another embodiment, infrared transmission and reception of the power on/off or light source signals could be used. And, different connector types could be used with a separate port for each feature control. Also, while the display has been described with respect to video images, the display could also easily display still images. And, while controls for brightness, light control and power have been shown, other controls could also be incorporated into the display, e.g., video pause or display contrast. Additionally, the form and details of the display assembly and handle assembly could be altered to achieve the rotation of the display screen in analogous ways. For example, the screen itself could be made to rotate within the display housing assembly, while the rest of display body stayed fixed relative to the handle assembly. Furthermore, the thumb wheel could be positioned for access by a finger instead of the thumb, and movement of the display could incorporate electro-mechanical means, instead of purely mechanical means.

What is claimed is:

CLAIMS

1. A handheld rotatable display for displaying images, the display comprising:

a handle assembly;

a display screen rotatably attached to the handle assembly; and

a rotation control mechanism, which facilitates rotation of the display screen relative to the display handle assembly.

2. The handheld rotatable display of claim 1, wherein the display screen is rotatable with respect to the handle assembly by up to about ±175 degrees.

3. The handheld rotatable display of claim 1, wherein the rotation control mechanism comprises:

a rotation actuator;

a display rotation gear rotatably attached to the handle assembly; and

a gear interface rigidly secured to the display screen and the display rotation gear and in operative communication with the rotation actuator such that manipulation of the rotation actuator causes rotation of the gear interface.

4. The handheld rotatable display of claim 3, wherein the rotation actuator is a thumb wheel

5. The handheld rotatable display of claim 3, wherein:

the display rotation gear defines a first wire opening therein; and

the gear interface defines a second wire opening therein, such that wires pass between the display screen and the handle assembly by passing through the first and second wire openings

6. The handheld rotatable display of claim 3, wherein the rotation control mechanism further comprises a gear train operatively controlled by the rotation actuator, wherein the gear train is comprised of plurality of gears, including the display rotation gear

7. The handheld rotatable display of claim 6, wherein the gear train is further comprised of a first gear and an idle gear.

8. The handheld rotatable display of claim 7, wherein:

the rotation actuator is in operative communication with the first gear, such that manipulation of the rotation actuator causes rotation of the first gear,

the first gear is in operative communication with the idle gear and, when rotated, causes a corresponding rotation of the idle gear in the opposite direction of the rotation of the first gear; and

the idle gear is in operative communication with the display rotation gear and, when rotated, causes a corresponding rotation of the display rotation gear in the opposite direction of the idle gear

9. The handheld rotatable display of claim 3, wherein the display screen resides within a display screen housing, the display screen housing comprising:

a display body front piece, through which the display screen is viewable; and

a display body rear piece secured to the display body front piece, the display body rear piece comprising.

10. The handheld rotatable display of claim 1, wherein the display screen resides in a display screen housing and the rotation control mechanism further comprises:

a rotation channel formed at a rear area of the display screen housing;

a circular lip protruding from and integrated into the handle assembly, wherein the circular lip rests within the rotation channel and glides therein throughout the rotation of the display screen relative to the handle assembly; and

a detent that blocks rotational movement of the circular lip within the rotation channel at a predetermined relative angular position between the lip and the channel

11. The handheld rotatable display of claim 1, wherein the display screen is part of a display screen housing assembly, the display screen housing assembly, further comprising:

a display body front piece through which the display screen is viewable; and

a display body rear piece which attaches to the display body front piece, wherein the combination of the display body front and rear pieces are part of a display screen housing, in which is secured the display screen.

12. The handheld rotatable display of claim 1, wherein the handle assembly comprises:

a handle body having an elongated gripping portion formed therein and wherein grasping the gripping portion with one hand by a user allows the handheld rotatable display to be held; and

an interface plate secured to the handle body.

13. The handheld rotatable display of claim 12, wherein the handle assembly further comprises a hand securing mechanism, which removably secures the user's hand to the handheld rotatable display.

14. The handheld rotatable display of claim 13, wherein the hand securing mechanism locates the user's hand so as to allow manipulation of the rotation control mechanism with said hand

15. The handheld rotatable display of claim 13, wherein the hand securing mechanism comprises:

a first strap bar secured to the handle body at a top end of the body;

a second strap bar secured to the handle body at a bottom end of the body; and

an elongated strap having a top end and a bottom end, wherein the strap top end secures to the first strap bar and the strap bottom end secures to the second strap bar, and the user's hand fits between the strap and the handle body.

16. The handheld rotatable display of claim 1, further comprising:

an image data receiver port, by which image data is received by the handheld rotatable display; and

a AC power input port, by which AC power is provided to the handheld rotatable display.

17. The handheld rotatable display of claim 1, further comprising an image data input/output port, through which video image data may be transmitted and received.

18. The handheld rotatable display of claim 1, wherein the handheld rotatable display is powered by an internal DC battery.

19. A handheld rotatable display, which may be held in and operated by a single hand of a user, comprising:

a display screen secured in a display screen housing;

a handle assembly rotatably attached to the display screen housing;

a rotation control mechanism, which causes rotation of the display screen relative to the handle assembly in response to the user's manipulation of a rotation actuator;

an image data reception mechanism; and

a set of image data processing electronics, which process the received image data for display on the display screen.

20. The handheld rotatable display of claim 19, wherein the display screen housing includes the rotation actuator.

21. The handheld rotatable display of claim 19, wherein the handle assembly includes the rotation actuator.

22. A handheld rotatable display, which may be held in and operated by a single hand of a user, comprising:

a display screen secured in a display screen housing;

a gear interface secured to a rear side of the display screen housing;

a thumb wheel integrated into the rear side of the display screen housing and accessible by the thumb of the single hand of the user which holds the display, wherein rotation of the thumb wheel causes rotation of the display screen;

a handle assembly, including an interface plate secured to a handle body, wherein the handle body includes an elongated portion to allow gripping by the single hand of the user;

a display rotation gear secured within the handle assembly, rotatably seated within the interface plate, and rigidly secured to the gear interface;

a hand securing mechanism that secures to the user's hand to the handle body;

an image data reception mechanism; and

a set of image data processing electronics, which process the received image data for display on the display screen.

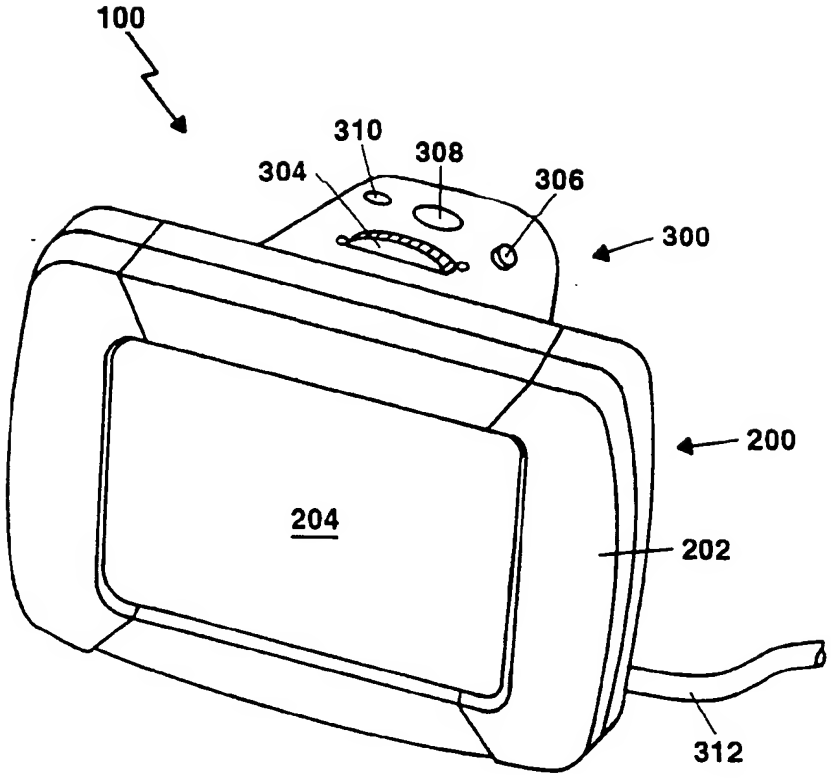

Figure 1

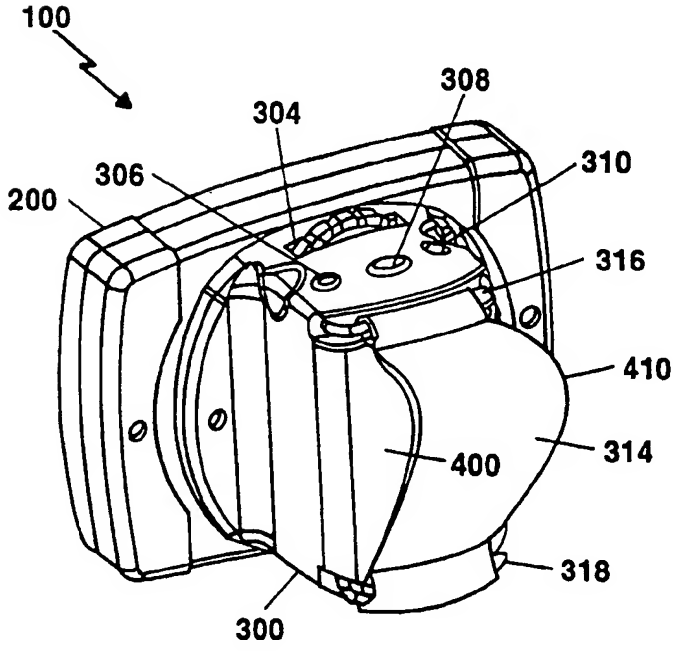

Figure 2

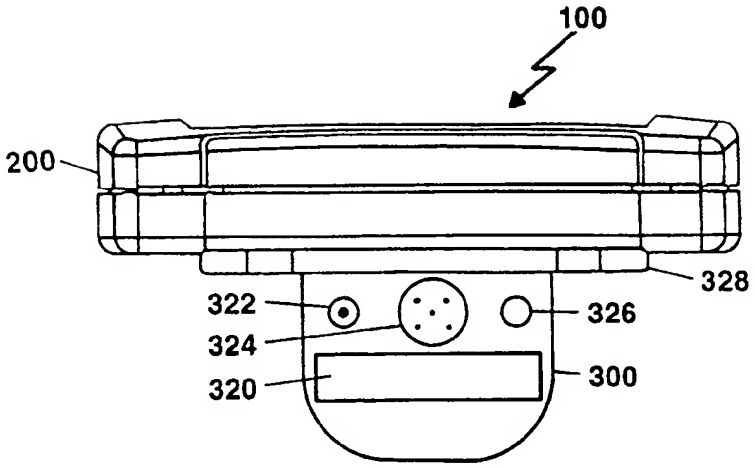

Figure 3

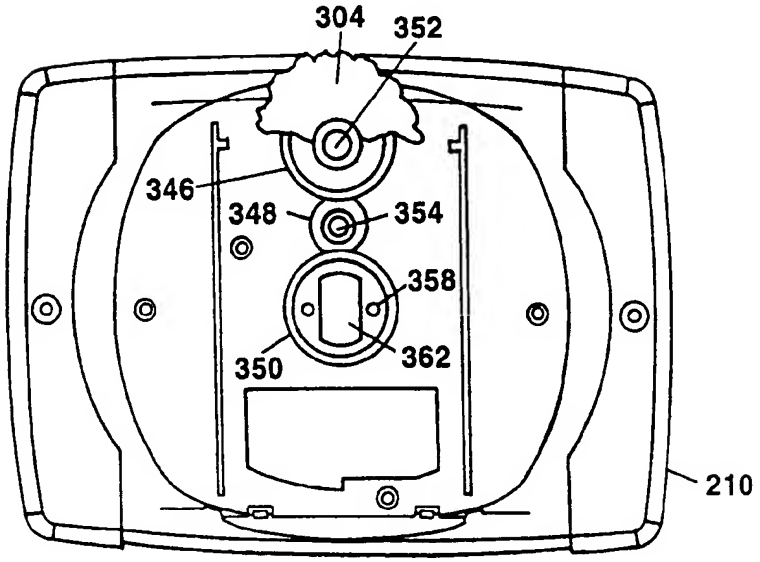

Figure 6

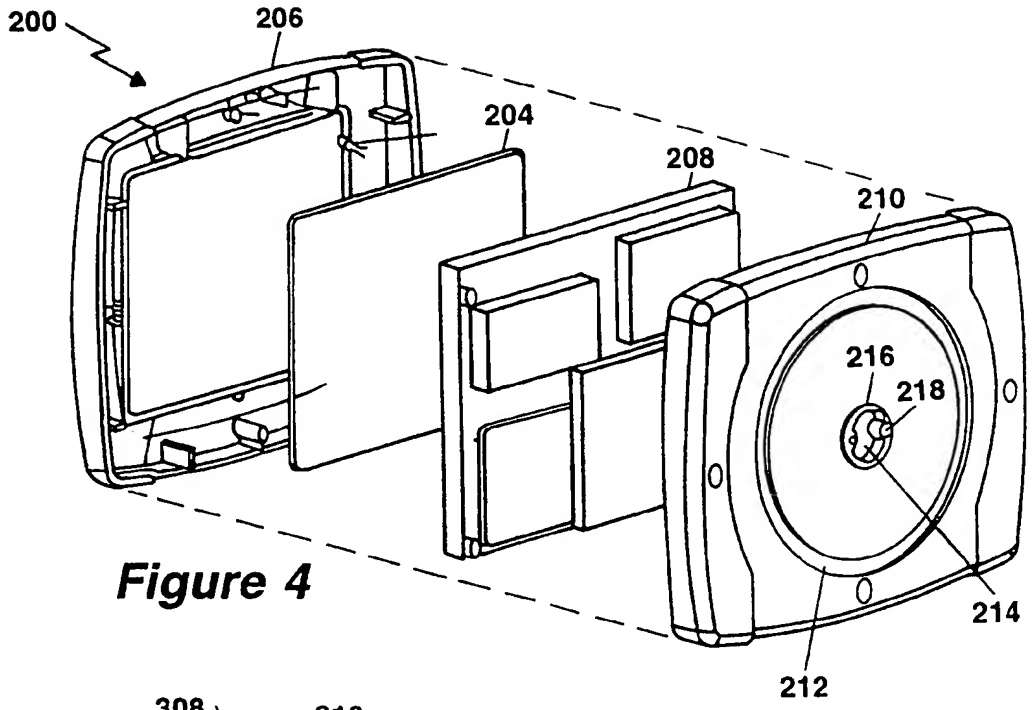

Figure 4

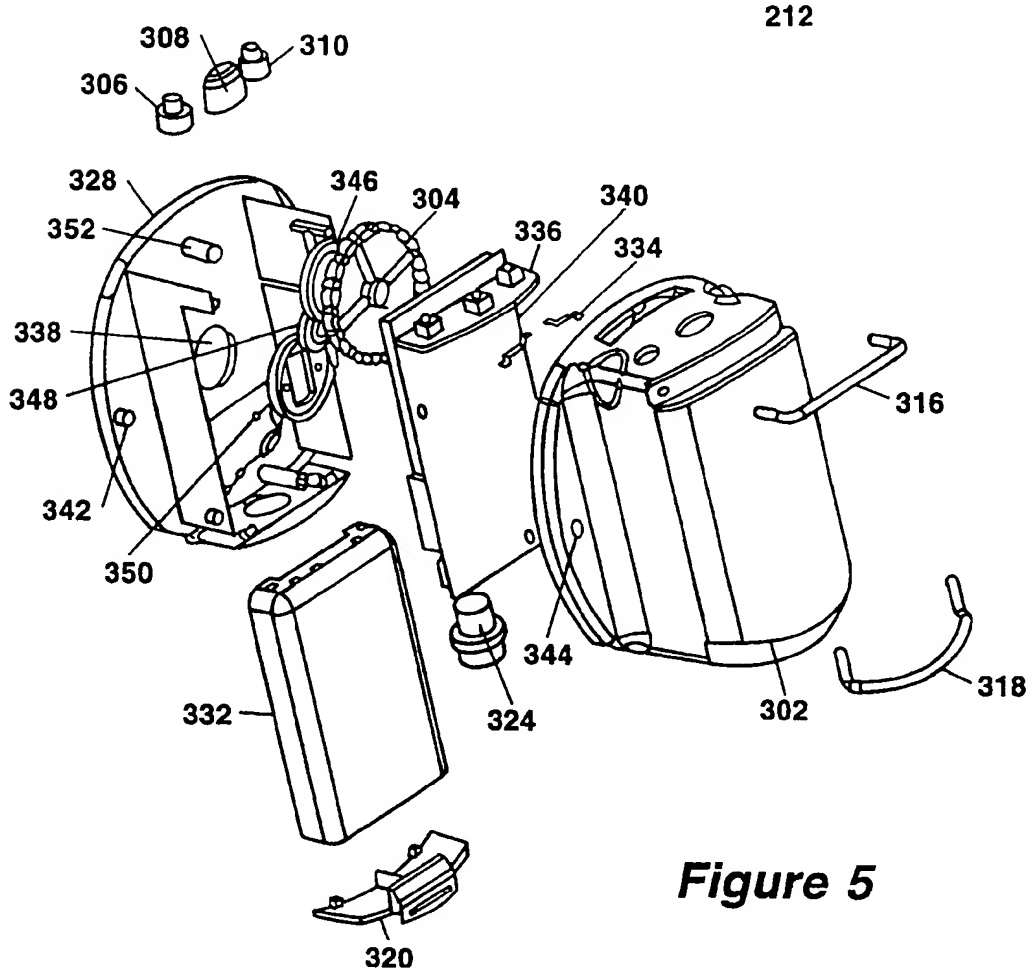

Figure 5

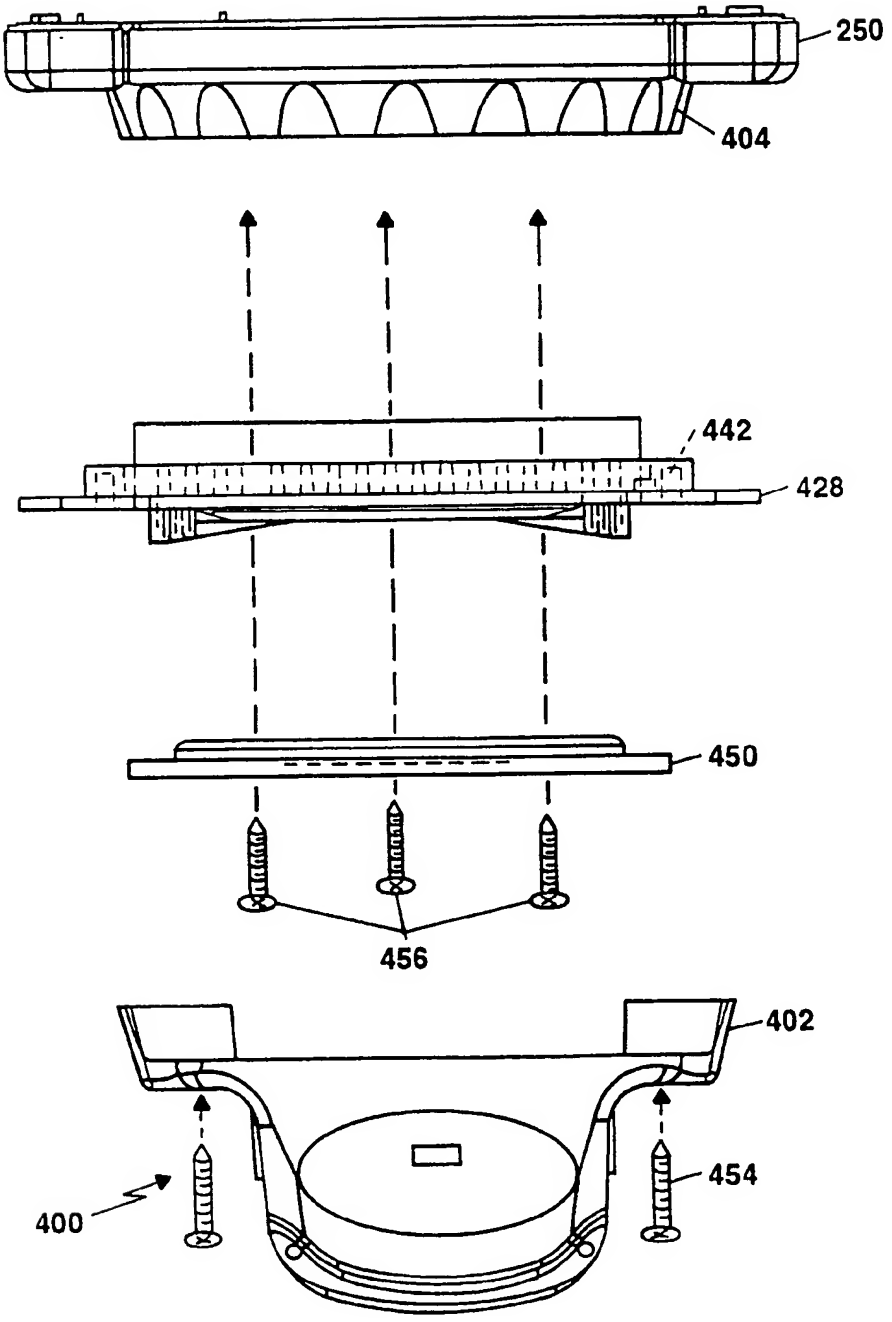

Figure 7

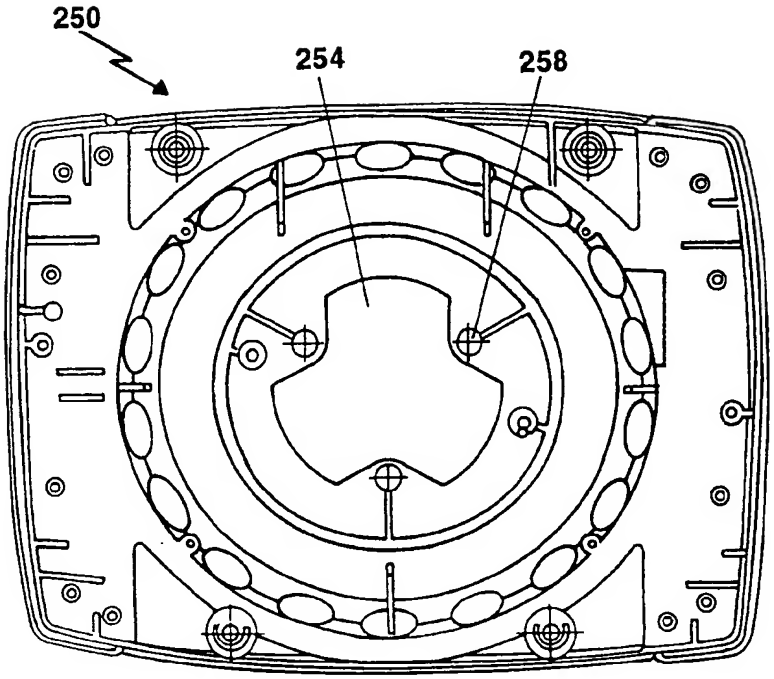

Figure 8A

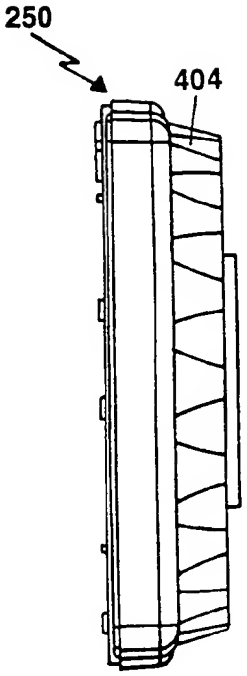

Figure 8C

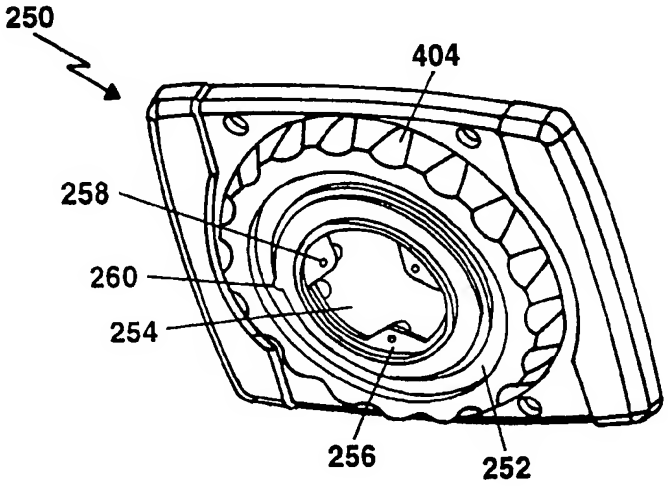

Figure 8B

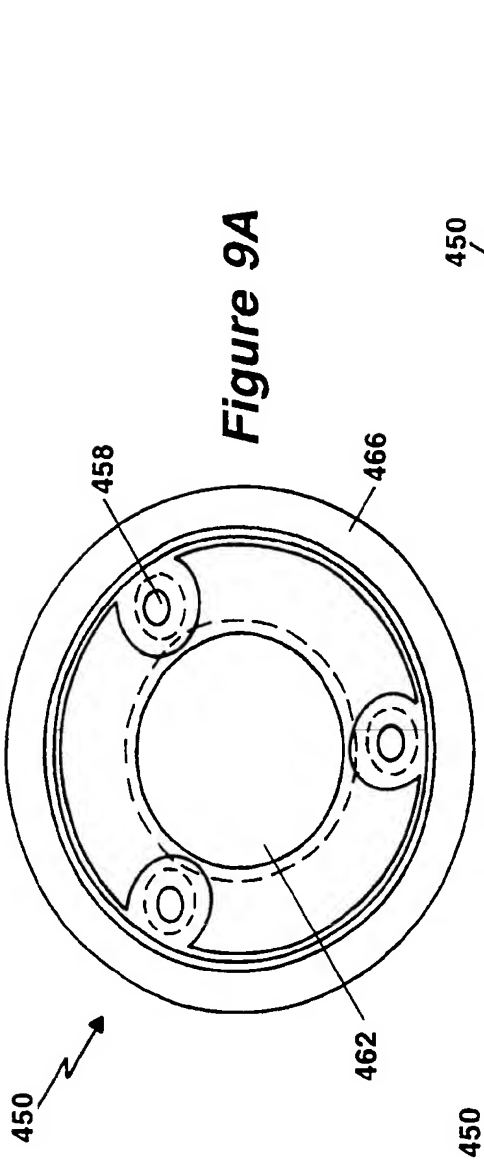

Figure 9A

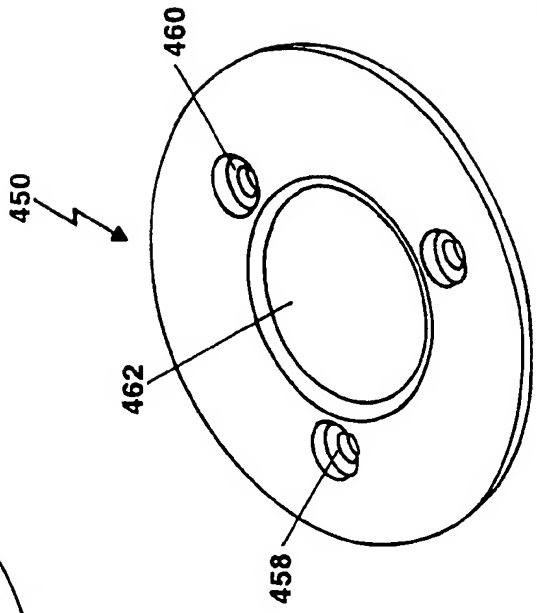

Figure 9C

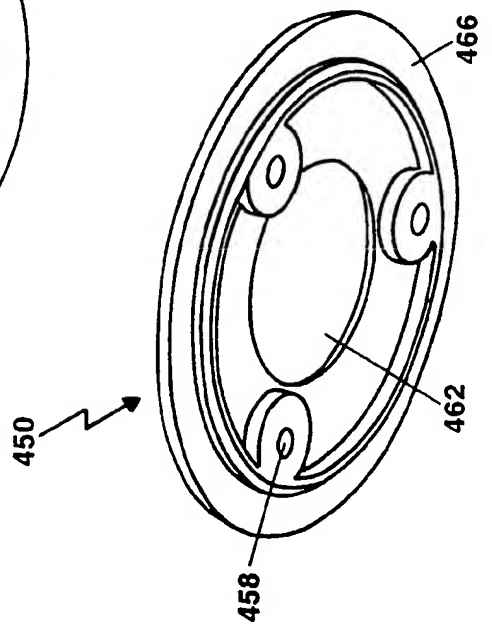

Figure 9B

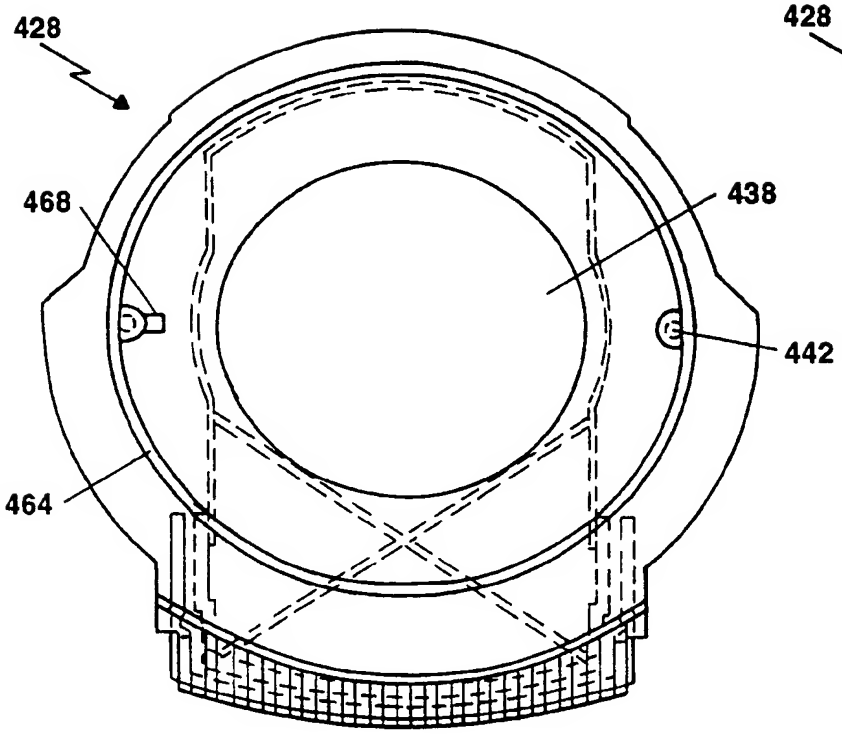

Figure 10A

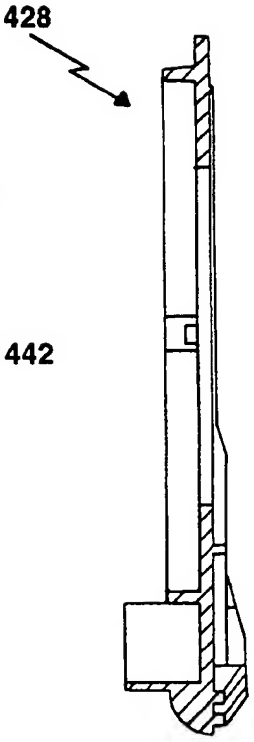

Figure 10C

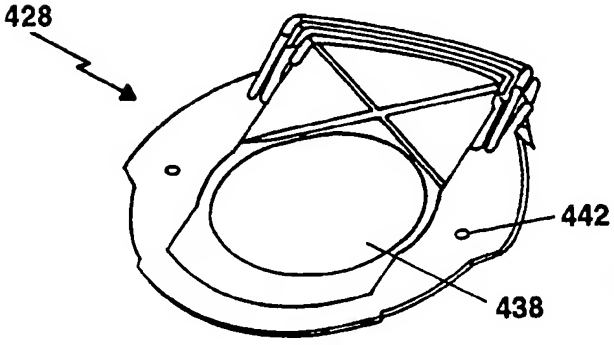

Figure 10B

INTERNATIONAL SEARCH REPORT

Interna il Application No
PCT/US 98/24002

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/655

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N F16M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 297 10 833 U (ADI CORP TAI PING SHIANG) 28 August 1997 see the whole document ---	1-3, 9-11,19, 22
A	DE 40 27 556 A (LICENTIA GMBH) 5 March 1992 see the whole document ---	1-3, 9-11,19, 22
A	US 4 555 081 A (ERMANSKI ALBERT G) 26 November 1985 see column 1, line 62 - column 2, line 12 see column 3, line 14 - column 6, line 64; figures 1-14 -----	1,3,4, 19,22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 March 1999	08/03/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Fuchs, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
PCT/US 98/24002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 29710833 U	28-08-1997	NONE	
DE 4027556 A	05-03-1992	NONE	
US 4555081 A	26-11-1985	CA 1196369 A	05-11-1985